

Final Report

For period February 1, 1974 - January 31, 1975

(NASA-CR-141285) THE MEASUREMENT AND
FACILITATION OF COOPERATIVE TASK

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The Measurement and Facilitation of Cooperative Task Performance

NGR 23-014-002, Supplement No. 3

Ronald R. Hutchinson, Principal Investigator

Research Department

Kalamazoo State Hospital

Kalamazoo, Michigan 49001

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Final Report

2/1/74 ~ 1/31/75

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This laboratory has been involved in the study of stress and the reactions of animals and humans to stress-exposure. The method for measuring reactions to stress in humans involves a series of electrical recordings of the muscles of the face - more specifically the masseter and temporalis muscles. We have conducted several studies in humans to determine that contraction of these muscles is produced by the same conditions of noxious events that produce biting in the squirrel monkey. A substantial series of experiments has now been completed documenting the validity and reliability of the jaw clench measure as it relates to the measurement of anger and stress contact.

Experiments have been completed showing that the onset of loud noise produces consistent jaw clenching and other correlated negative affect motor behaviors. Similarly, the termination of a positive reinforcer, i.e. consumption of cigarettes, also produces jaw clenching. Further studies showed that termination of secondary positive reinforcers, such as the delivery of coins or termination of tertiary positive reinforcers, such as interruptions of counts on a counter, also led to immediate increases in jaw clenching.

Three series of experiments have been done ^{done} to determine under what conditions jaw clenching will occur.

1) Experiments involving a high fixed-ratio response requirement have shown that jaw clenching in humans occurs in an analogous fashion to the

biting produced with similar increases in fixed-ratio schedules in in-frahuman subjects.

2) Experiments involving reduction in the amounts of money received for particular tasks or simple reduction in delivery of money independent of any work cause increases in the jaw clench response and other negative affect motor behaviors.

3) Experiments have demonstrated that perception of more favorable conditions existing for another person can actually increase anger and hostility, even though no actual reductions in reinforcement occur for the subject under study.

The results from these experiments presented in the attached figures provide good validation that the measures of jaw clenching are a valid index of anger and hostility and correlate well with other overt actions such as cursing, hitting the machine testing apparatus, etc. Data collected also indicate that this jaw clench measure is suitable for the determination of disruption in social cooperative performances in small groups.

BIBLIOGRAPHY

Proni, T. J. The effects of changes in response-independent pay upon human masseter EMG. Masters thesis, Western Michigan University, December 1973.

Keenan, D. M. The effects of simultaneous but unequal response-independent pay to pairs of human subjects of masseter EMG and bodily movements. Masters thesis, Western Michigan University, August 1974.

FIGURE LEGENDS

Page 1

Figure upper right: A schematic illustration of the electrode placements for the recording of temporalis and masseter muscle electromyographic activity.

Figure upper left: Tracings of unintegrated and integrated electrical activity associated with contraction of the masseter muscle.

Figure lower left: Illustrations of the two bite transducers used for the determination of linear relation between peak to peak EMG amplitude and bite force.

Figure lower right: Tracings of masseter and temporalis electromyographic activity during concentric occlusion and eccentric occlusion. Concentric biting involves opposition of the incisors while eccentric biting involves closure of the jaw at the normal resting position with the lower mandible recessed slightly.

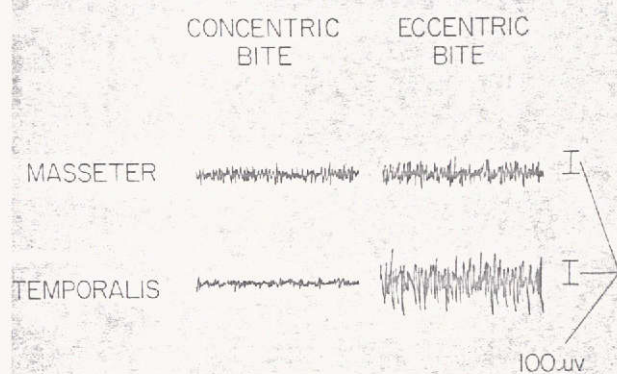
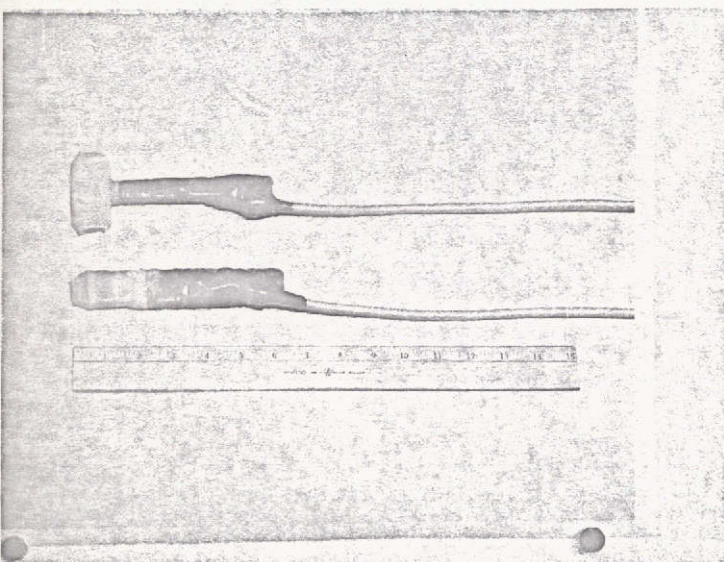
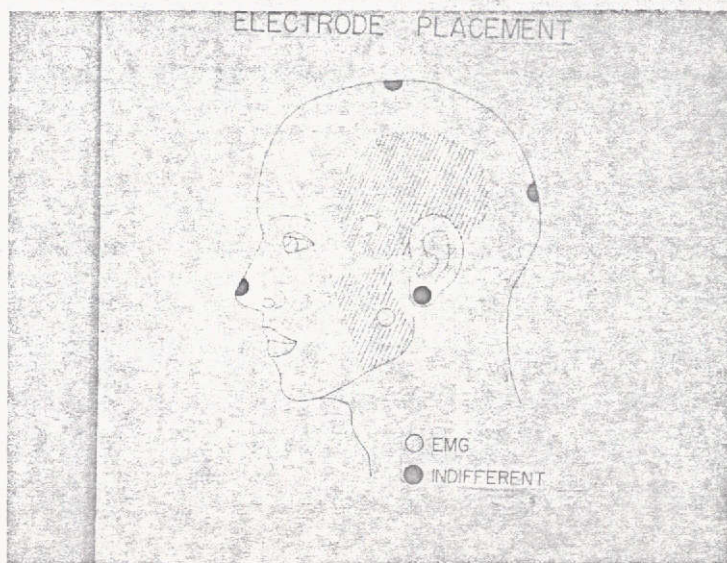
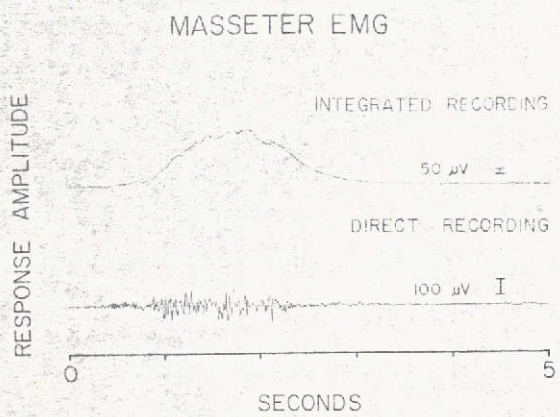


Figure Legends

Page 2

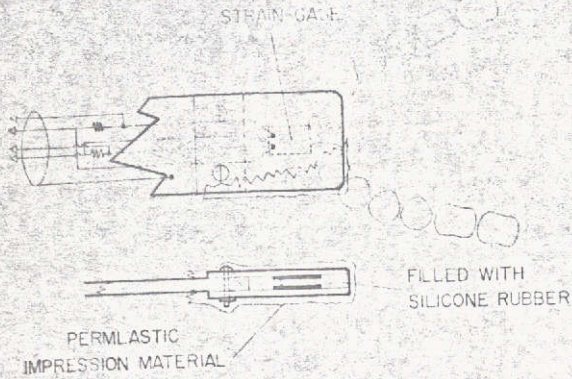
Figure upper left: Schematic illustration of the bite force strain gauge transducer system for the measurement of concentric occlusion forces.

Figure upper right: Schematic illustration of the bite force strain gauge transducer system for the measurement of eccentric occlusion forces.

Figure lower left: Relationship between transducer output in millivolts as a function of masseter and temporalis potentials in microvolts during eccentric occlusion in four subjects.

Figure lower right: Illustration of linear input-output relationships for both concentric and eccentric transducers.

CONCENTRIC TRANSDUCER



ECCENTRIC TRANSDUCER

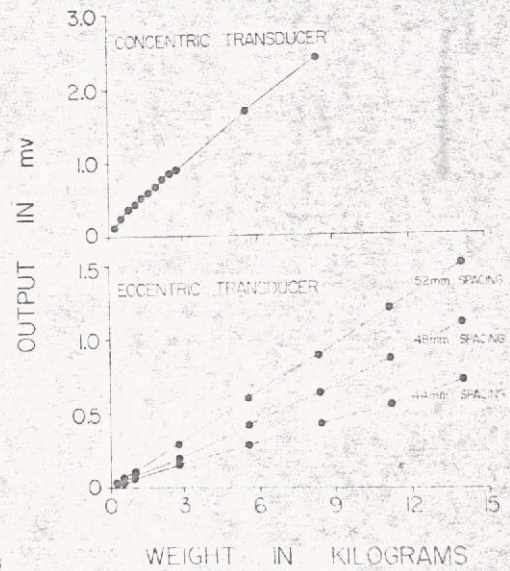
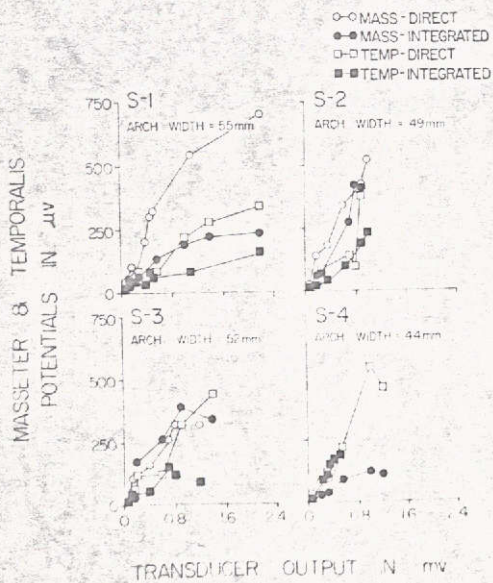
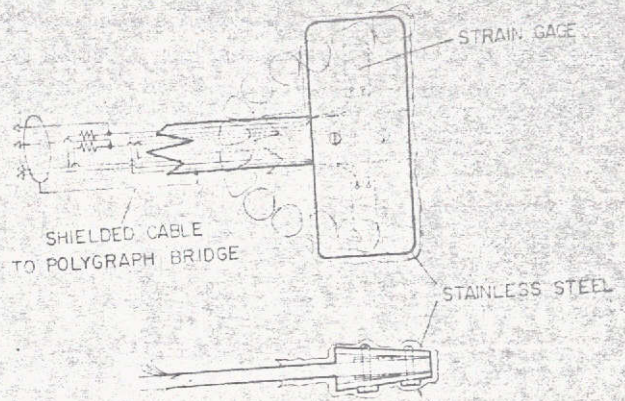


Figure Legends

Page 3

Figure upper left: Plot of relationship between transducer output in millivolts and recorded masseter and temporalis potentials in microvolts during concentric occlusion for four subjects.

Figure upper right: Effects of intense but brief noise bursts upon biting by four subjects. Note that two subjects show anticipatory bites.

Figure lower left: Plots for four subjects of biting subsequent to the delivery of a loud noise at zero time for the three minute inter-noise interval. Note that each subject shows a peak of biting immediately after noise delivery and one subject shows anticipatory biting prior to ensuing noise deliveries.

Figure lower right: Effect of smoking termination on the amplitude and duration of masseter muscle contraction. Figures are improperly labeled, the smoking curve should really be the no smoking curve and vice versa.

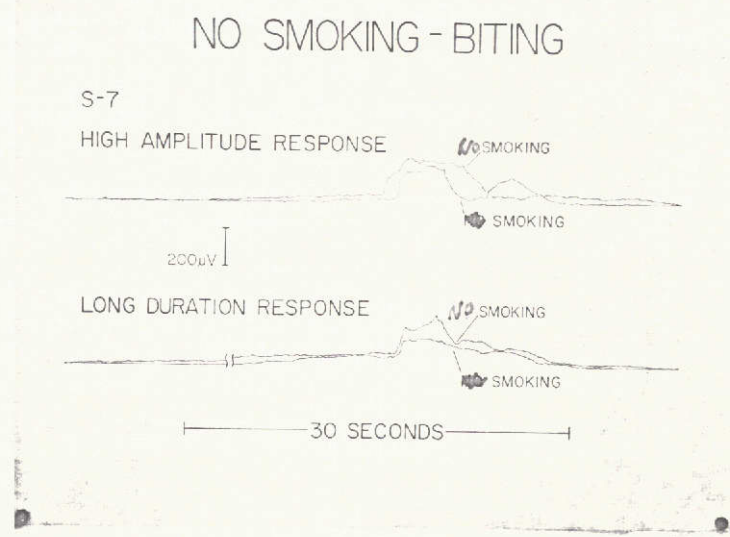
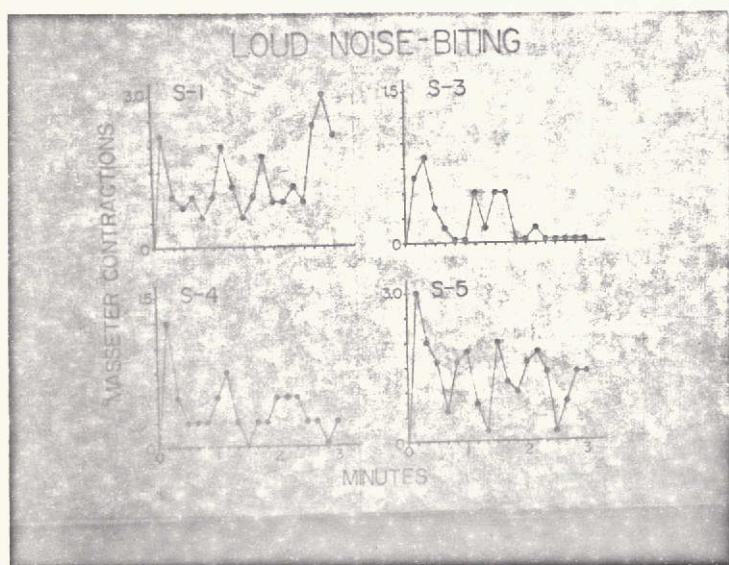
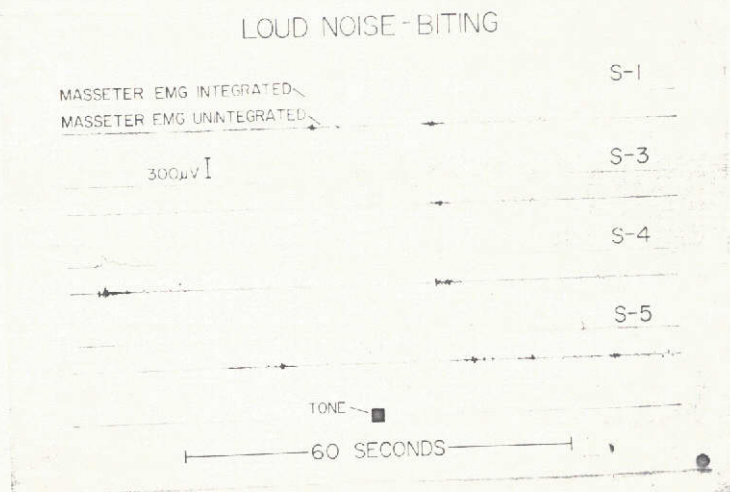
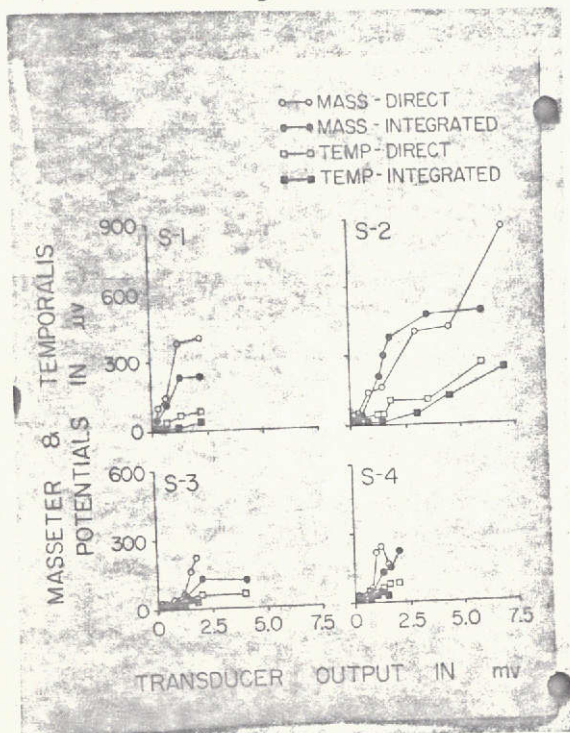


Figure Legends

Page 4

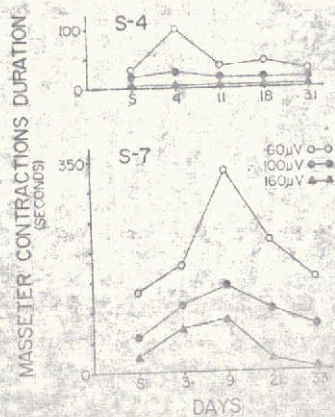
Figure upper left: Pattern of masseter muscle contractions over subsequent days following termination of smoking by smokers. The closed circles involve the masseter contraction sample values for the last day of smoking and open circles for subsequent days of no smoking.

Figure upper right: Figure relating masseter muscle contractions over several days subsequent to cessation of smoking in two subjects at three different EMG amplitudes. Note the pattern is similar for both subjects in that the amplitude of the EMG activity at the three different values all increase progressively for several days and then decrease.

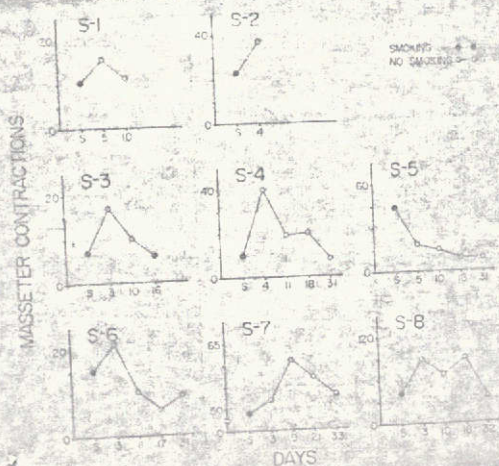
Figure lower left: Pattern of temporalis and masseter muscle contraction during fixed-ratio button press reinforcement. Note that biting responses occur in the post reinforcement pause of early portions of the fixed-ratio response sequence.

Figure lower right: Effect of extinction following fixed-ratio reinforcement upon masseter and temporalis contraction. Note that both rapidly increase and then gradually decrease.

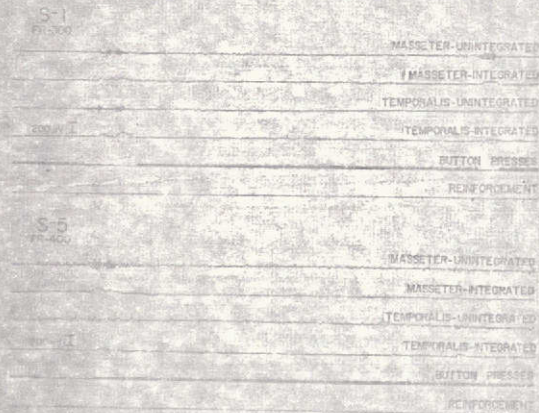
NO SMOKING-BITING



NO SMOKING-BITING



FR RESPONDING-BITING



FR EXTINCTION-BITING

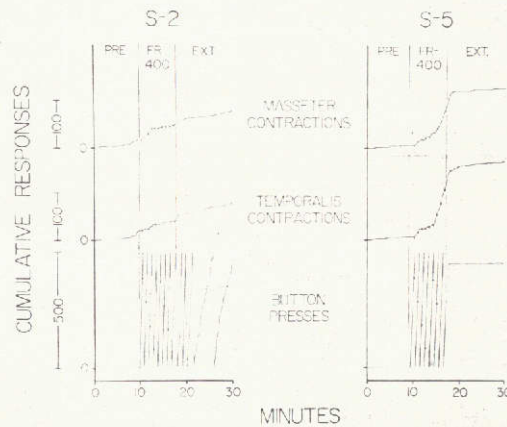


Figure Legends

Page 5

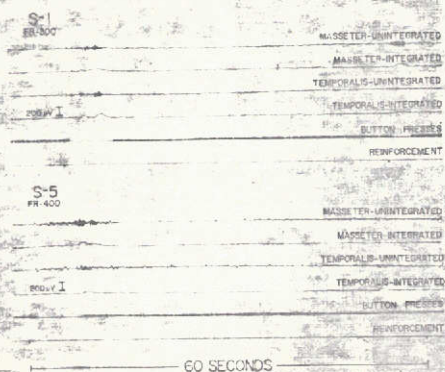
Figure upper left: Figure illustrating the progressive increase in masseter and temporalis EMG activity as fixed-ratio responding starts to break up during extinction after fixed-ratio reinforcement.

Figure upper right: Illustration for five subjects showing the relationship between the probability of temporalis and masseter muscle contractions and the length of fixed-ratio pauses.

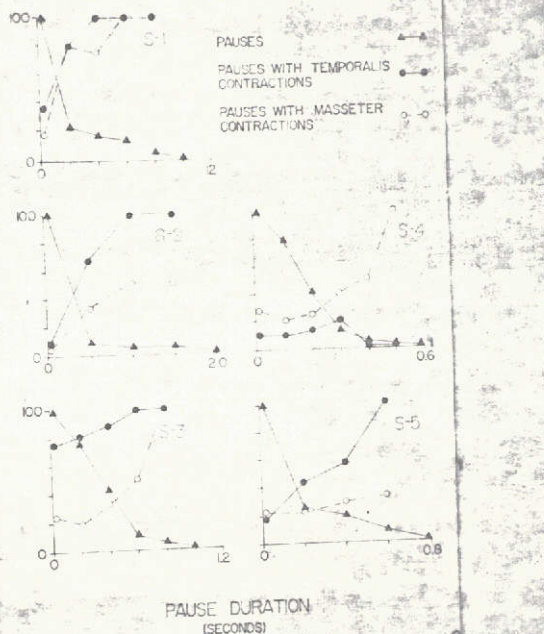
Figure lower left: Illustration for four subjects showing increases in biting subsequent to pay termination.

Figure lower right: Illustration of the increases in biting by four subjects subsequent to pay reductions. Note that the two male subjects show slower but more prolonged biting whereas female subjects tend to cease biting more rapidly after such reductions.

FR RESPONDING-BITING

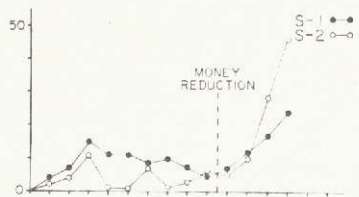


PAUSE DURATION-BITING

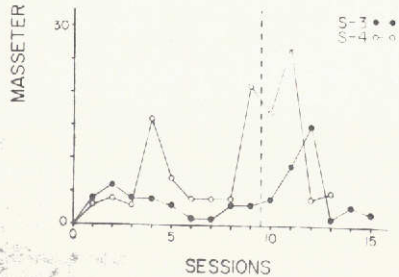


PAY REDUCTION-BITING

MALE SUBJECTS



FEMALE SUBJECTS



PAY TERMINATION-BITING

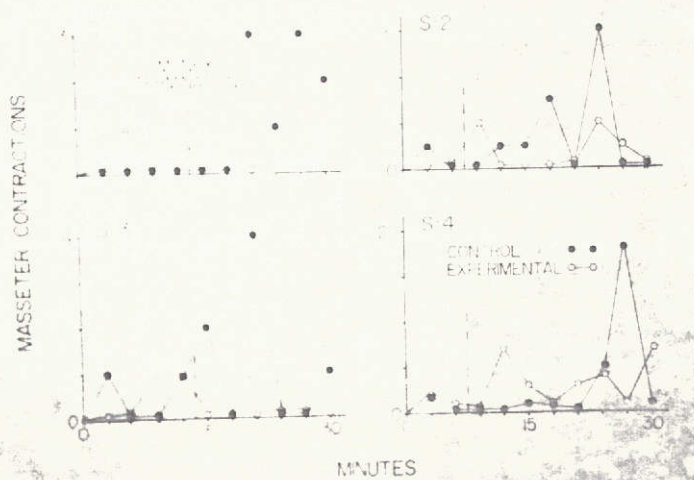


Figure Legends

Page 6

Figure upper left: Illustration of the relative frequency of masseter muscle contractions and other physical control movements as a function of various values of pay for five subjects.

Figure upper right: Illustration of the differences in masseter muscle contractions during pay increases and pay decreases.

Figure lower left: Changes in physical movements as a function of the amount of pay during ascending and descending pay value sequences.

Figure lower right: Comparison (for five subjects) of the levels of masseter contractions and control muscle movements at the five dollar pay value condition and the one dollar pay value condition across the inter-pay interval. Note that at the high levels of reinforcement, control activity levels are significantly above biting whereas the reverse is true at low levels of reinforcement.

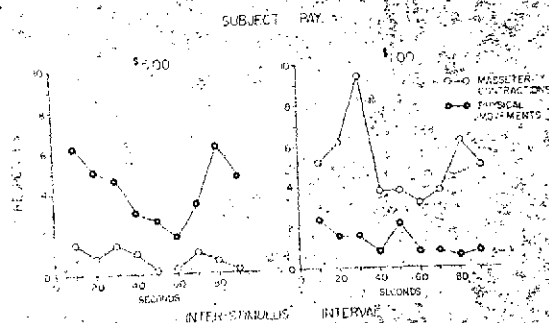
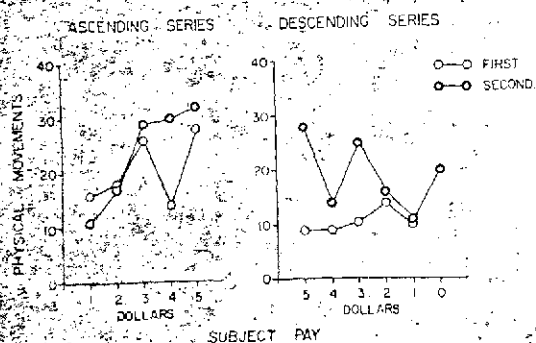
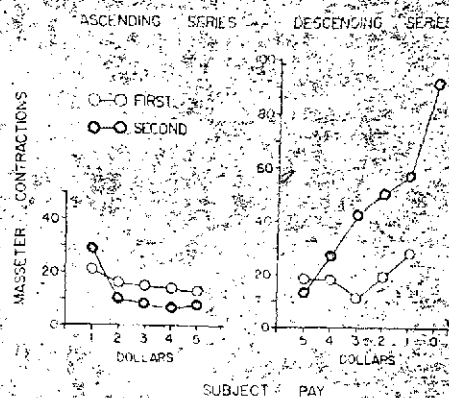
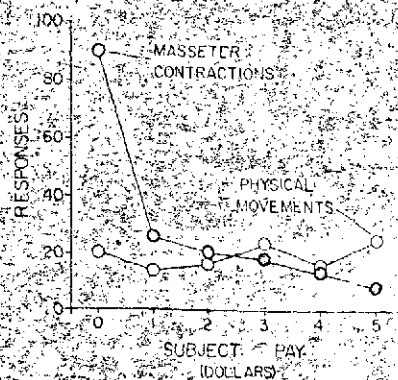


Figure Legends

Page 7

Figure upper left: Separate illustrations of the differential effect of ascending and descending pay value sequences for five subjects as they effect masseter muscle contractions.

Figure upper right: Illustration for five individual subjects showing the relatively greater biting during the one dollar pay value. Note, the five dollar and one dollar labels should be reversed.

Figure lower left: Illustration of typical fixed-ratio responding under selected fixed-ratio values for two subjects.

Figure lower right: Illustration of correspondence between hitting with the forearm and fist, masseter muscle contractions, and cursing subsequent to a missed reinforcement delivery.

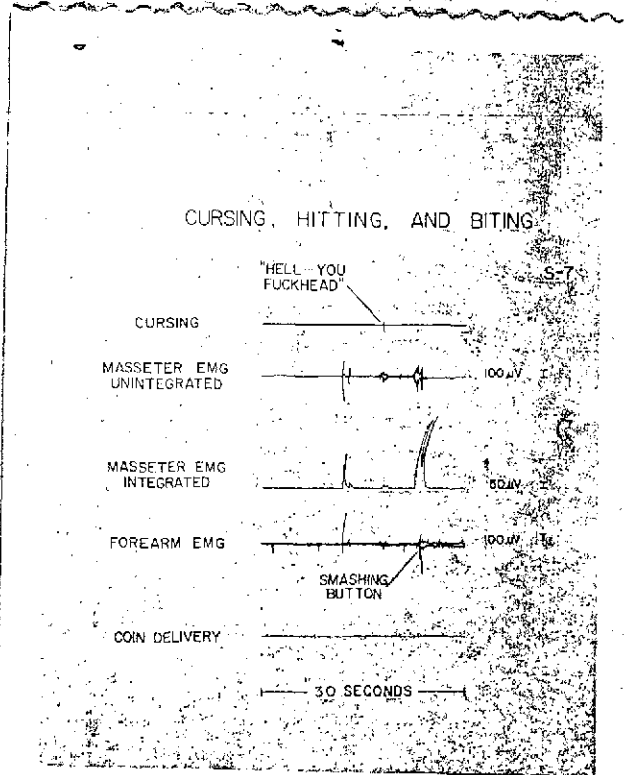
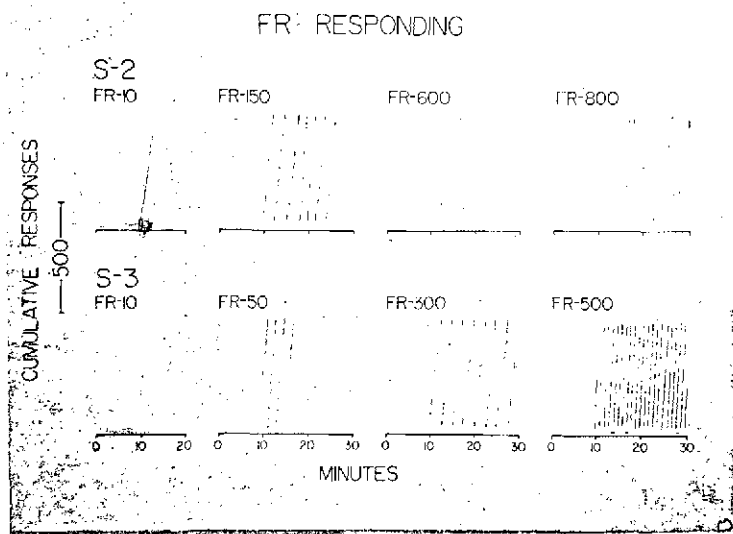
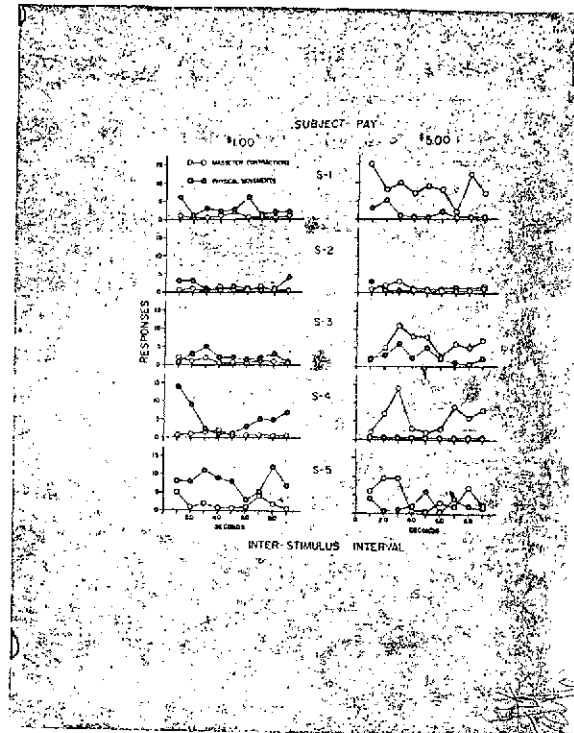
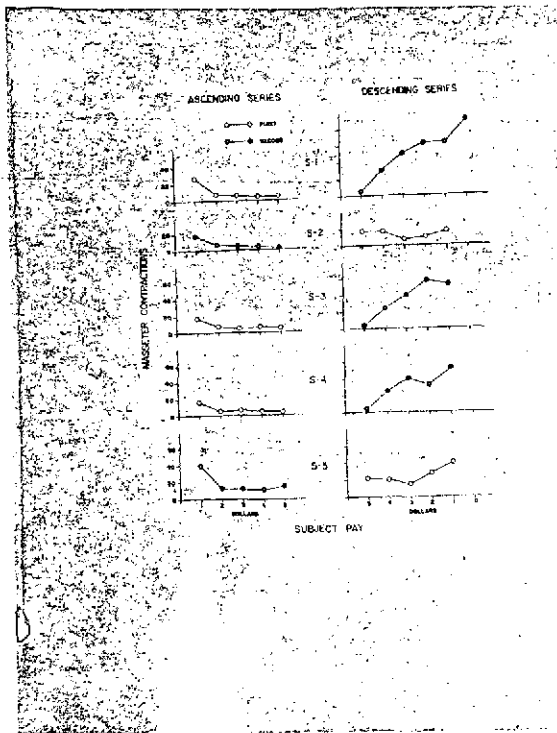


Figure Legends

Page 8

Upper figure: Illustration of masseter muscle contraction subsequent to the transition from coin deliveries to delivery magazine noise only.

Lower figure: Compilation of various verbal statements by two subjects at selected monetary reward values. Though the figure here reduced is illegible it basically portrays happy, amused and self congratulatory type reports at high monetary values and cursing, self deprecation and expletives at low monetary values.

EXTINCTION-BITING

S-8

MASSETER EMG
INTEGRATED

MASSETER EMG
UNINTEGRATED

— COIN DELIVERY — MAGAZINE NOISE ONLY —

60 SECONDS

50 μ V

100 μ V

S-1

VERBAL STATEMENTS

1 1 1 1 2 2 2 3 1 2 4 4 4 5 5 5 4 4 3 3 2 1 1 0 DOLLARS

S-2

5 5 5 5 4 4 4 3 3 2 2 1 1 1 2 2 3 3 4 4 5 1 DOLLARS

SUBJECT PAY